continually affected the price of wheat. On the other hand the greater portion of the spring wheat section was visited with frequent showers, especially in Kansas and in the middle Missouri Valley.

The most marked storm of the month developed in the Rocky Mountain region on the 5th and moved across the district on the 6th, 7th, and 8th, causing extensive, and sometimes severe, thunderstorms. Forecasts for thunderstorms were made well in advance of the movement of the storms.

In anticipation of the cool weather and frosts which overspread the greater portion of the district on the 3d, 4th, and 5th, warnings were widely issued beginning with the 2d. Frost warnings were also issued on the 9th for the frosts which occurred over the eastern portion of the district on the 10th.

On the morning of the 10th, in anticipation of a general change from low to high temperatures in the district, the following long range forecast was issued:

> The indications are for generally fair and warmer weather throughout the district, except in the northern Rocky Mountain region where showers are probable. The warm weather in the central valleys and upper Lake region should continue for several days.

This forecast was fully verified as the temperature continued to rise almost without interruption for three days, and the warm spell did not break in the eastern portion of the district until the 15th and 16th.

No storm moved across the upper Lake region during the month which was attended by winds sufficiently strong to seriously affect the movement of vessels.—*H. J. Cox, Professor.*

## SAN FRANCISCO FORECAST DISTRICT.

The month opened with general rain over the San Joaquin and Sacramento valleys, extending across the Sierras into Nevada. Unusually heavy rains fell in southern California, beginning May 4. These rains were not forecast on the morning of May 3, as there was considerable doubt in the forecaster's mind that the pressure distribution warranted at this time of the year any forecast of rain. By the evening of the 3d, however, conditions were such that forecasts were made that the rain would continue. Such rain conditions are unprecedented, and therefore it is interesting to note that, although the exact beginning of the rain was not forecast, the continuation of it, when nearly everyone would have expected a cessation, was a decided justification of the methods employed in forecasting.

By May 5 the rain had been very heavy over the entire State of California. The value of this rain can hardly be overestimated, coming at the most opportune time for vegetation.

The second rain period of the month occurred on the 10th and 11th, and was successfully forecast. In southern California the precipitation was light, but in the San Joaquin Valley it was unusually heavy, some stations receiving nearly 2 inches from the storm. The rainfall at Fresno at this time exceeded that of any May for the past eighteen years. On May 11 warnings of high north winds, heavy showers, and much colder weather for Friday and Saturday were sent throughout eastern California, Nevada, and Utah. The warnings were verified at nearly all points. A rainfall of 1.16 inches was reported at Winnemucca on the morning of May 12.—*Alexander G. McAdie, Forecast Official.*

## PORTLAND, OREG., FORECAST DISTRICT.

Two storms occurred in this district during the month; the first, on the afternoon of May 23, was the most severe, and a number of fishing boats at the mouth of the Columbia River were capsized and three fishermen drowned. Besides these casualties, considerable property, both on land and water, was damaged. The second storm occurred on the 25th, and was not so destructive. Timely warnings were issued for both storms, the first being covered by storm warnings and the second by an advisory message.

The spring rise this year in the Columbia River, due to the melting of snow in the mountains, was small, and daily river forecasts and bulletins were only necessary from May 9 to the 26th. The maximum height reached at Portland was 17.8 feet, and the river forecasts were of considerable value, as cellars and wharfs in the city are flooded when the river stands between 15 and 19 feet.—*E. A. Beals, Forecast Official.*

## HAVANA FORECAST DISTRICT.

No general storms occurred and no special warnings were issued during the month.

On the 4th, 11th, and 31st notice of brisk to high north to east winds over the south Atlantic was sent to points on the coasts of Cuba, Haiti, Santo Domingo, and Puerto Rico.—*W. B. Stockman, Forecast Official.*

## AREAS OF HIGH AND LOW PRESSURE.

During the month there were seven highs and nine lows sufficiently well defined to admit of being charted. (See Charts I and II.)

*Highs.*—Four of the highs were first observed in the British Northwest Territory, one on the northern Pacific coast, one in western Minnesota, and one to the north of Lake Superior. No. I was very well defined and altogether the most important high of the month. Appearing to the north of western Montana on the morning of the 1st, it moved slowly nearly due east, and on the morning of the 2d was central, with slightly increased pressure, north of the Dakotas. It entered the United States during the 2d, and for two days its course was nearly due south, the crest reaching the Louisiana coast on the evening of the 4th. On the morning of the 5th it was central at Jacksonville, Fla., and on the night of the 5th it passed into the Atlantic off the South Carolina coast. Its initial pressure (30.20) was maintained with very slight variations during its entire course. The temperature falls along its path were quite pronounced from the Canadian line to central Texas, freezing weather occurring in portions of North Dakota and Minnesota on the morning of the 2d, and frosts, ranging from light to killing, throughout the upper Mississippi Valley, and thence westward to central Colorado, on the morning of the 3d. A few light frosts were also reported from the Ohio Valley and Tennessee on the morning of the 4th. No. II appeared to the north of Lake Superior on the morning of the 6th, and moving southeastward, with increasing pressure, passed into the ocean off the New Jersey coast during the night of the 7th. Light to killing frosts marked its course through the lower Lake region, western New York, eastern Pennsylvania, and West Virginia.

No. III, which was first observed to the north of eastern Montana on the morning of the 8th, was attended throughout its course, from the Canadian line to the Carolina coast, with the highest pressure of the month. On the morning of the 10th its crest was central over the lower Ohio Valley, causing frosts northward to the Great Lakes and eastward to central Pennsylvania and western Maryland.

No. IV was of slight intensity and short duration. Appearing on the north Pacific coast on the morning of the 14th, it moved rapidly eastward and disappeared in the Rocky Mountains during the 15th.

Nos. V and VI appeared north of the Dakotas and passed off to the eastward without entering the United States.

No. VII appeared in the Red River of the North Valley during the 19th, pursued a southeasterly course to northern Kansas, and thence nearly due east to the North Carolina coast. It was of slight intensity and unimportant in its relation to temperatures.

*Movements of centers of areas of high and low pressure.*

| Number. | First observed. | | | Last observed. | | | Path. | | Average velocities. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Date. | Lat. N. | Long. W. | Date. | Lat. N. | Long W. | Length. | Duration. | Daily. | Hourly. |
| High areas. | | ° | ° | | ° | ° | *Miles.* | *Days.* | *Miles.* | *Miles.* |
| I | 1, a.m. | 51 | 114 | 5, p.m. | 33 | 80 | 2,800 | 4.5 | 622 | 25.9 |
| II | 6, a.m. | 48 | 89 | 7, p.m. | 38 | 74 | 1,000 | 1.5 | 667 | 27.8 |
| III | 8, a.m. | 51 | 104 | 11, a.m. | 33 | 80 | 1,800 | 3.0 | 600 | 25.0 |
| IV | 14, a.m. | 47 | 123 | 15, a.m. | 43 | 109 | 800 | 1.0 | 800 | 33.3 |
| V | 15, a.m. | 51 | 104 | 17, a.m. | 45 | 67 | 1,750 | 2.0 | 875 | 36.5 |
| VI | 18, a.m. | 50 | 100 | 19, a.m. | 48 | 85 | 700 | 1.0 | 700 | 29.2 |
| VII | 19, p.m. | 47 | 97 | 22, p.m. | 35 | 76 | 1,750 | 3.0 | 583 | 24.3 |
| Sums | | | | | | | 10,600 | 16.0 | 4,847 | 202.0 |
| Mean of 7 paths | | | | | | | 1,514 | | 692 | 28.9 |
| Mean of 16 days | | | | | | | | | 662 | 27.6 |
| Low areas. | | | | | | | | | | |
| I | 1, a.m. | 50 | 97 | 4, p.m. | 49 | 64 | 2,000 | 3.5 | 571 | 23.8 |
| II | 1, p.m | 32 | 87 | 3, p.m. | 43 | 70 | 1,300 | 2.0 | 650 | 27.1 |
| III | 5, a.m. | 54 | 114 | 9, p.m. | 46 | 60 | 3,775 | 4.5 | 839 | 35.0 |
| IV | 6, p.m. | 53 | 106 | 8, a.m. | 43 | 86 | 1,125 | 1.5 | 750 | 31.2 |
| V | 10, a.m. | 48 | 117 | 11, a.m. | 49 | 104 | 750 | 1.0 | 750 | 31.2 |
| VI | 11, p.m. | 50 | 110 | 13, a.m. | 50 | 100 | 875 | 1.5 | 583 | 24.3 |
| VII | 13, p.m. | 51 | 104 | 15, p.m. | 46 | 60 | 2,250 | 2.0 | 1,125 | 46.9 |
| VIII | 17, p.m. | 32 | 106 | 21, a.m. | 48 | 68 | 2,700 | 3.5 | 771 | 32.1 |
| IX | 22, a.m. | 29 | 95 | 24, p.m. | 35 | 76 | 1,250 | 2.5 | 500 | 20.8 |
| Sums | | | | | | | 16,025 | 22.0 | 6,539 | 272.4 |
| Mean of 9 paths | | | | | | | 1,781 | | 727 | 30.3 |
| Mean of 22 days | | | | | | | | | 728 | 30.4 |

*Lows.*—No. I was first observed in the upper valley of the Red River of the North on the morning of the 1st. Its course was nearly due east to the St. Lawrence Valley, and, except a slight increase of temperature and showers in the lower Lake region, northern New York, and New England, it affected but slightly the weather conditions in the United States.

No. II apparently developed over southern Alabama on the 1st. It moved eastward to the Florida coast, and thence northward along the Atlantic coast, merging into No. I at or near Portland, Me., on the morning of the 3d. It was accompanied by thunderstorms and light rains in the east Gulf and South and Middle Atlantic States and high winds on the middle Atlantic coast.

No. III developed in the British Northwest Territory near the one hundred and fifteenth meridian during the night of the 4th, and, entering the United States through Montana, it moved southeastward, with remarkable rapidity, to southern Kansas, and thence slowly northeastward across the Great Lakes to the north Atlantic coast. Thunderstorms and rains, in many instances heavy, marked its course from Kansas to the New England coast.

Nos. IV and V were without any features of special interest, No. IV merging into No. III, and No. V disappearing in North Dakota within twenty-four hours after its development in western Washington.

No. VI was a marked depression, but of short duration, and very erratic movement. Its effects were confined to the far northwest, where general rains fell over a large area of territory, embracing Montana and Washington.

No. VII originated in the British Northwest Territory and moved almost due east along the Canadian boundary line to Nova Scotia.

No. VIII developed in the upper Rio Grande Valley on the 17th, and moving northeastward with slowly decreasing pressure, reached the middle Atlantic coast on the 19th. Its course was thence north to the St. Lawrence Valley. Rains generally light and scattered accompanied this depression through the west Gulf States, central valleys, and Middle and New England States.

No. IX, which was probably of Gulf origin, appeared in southern Texas on the morning of the 22d, accompanied by heavy rain at Galveston and light rains throughout the eastern and central portions of Texas. It moved slowly northeastward and passed into the Atlantic off the North Carolina coast on the 24th. It caused general and heavy rains on the 23d in the east Gulf and South Atlantic States, and heavy rains along the south Atlantic coast on the 24th.—*Geo. E. Hunt, Chief Clerk, Forecast Division.*

## RIVERS AND FLOODS.

The floods of April continued in the lower sections of the Brazos and Tombigbee rivers until about the middle of the month; in the Brazos River the crest of the flood reaching the Gulf on the 17th. Many farms were overflowed below Waco, Tex., and a few of them were abandoned for the season. The water passed somewhat more rapidly out of the Tombigbee, and no damage to crops or loss of stock was reported after the 1st of May. On the first day of the month the water in this stream at Demopolis, Ala., stood 55.6 feet on the gage, which was 20 feet above the danger line, and on the 31st a gage reading of only 4.4 feet was recorded, giving the remarkable monthly range of 51.2 feet.

Although there was a gradual fall in the Mississippi River, a fairly good navigable stage of water continued throughout the month, except in the extreme upper section.

On the upper Ohio River the larger steamboats were tied up on account of low water from the 12th to the 30th, but resumed their trips on the 31st. No interruption to navigation was reported below Cincinnati.

The mean water stages in the Missouri, Arkansas, and Red rivers were slightly higher than those of the preceding month.

A detailed report of the Brazos River Valley flood, and freshets in other streams of Texas has been made by Dr. I. M. Cline, official in charge of the Weather Bureau office at Galveston, Tex., and is printed in another portion of this REVIEW.

The highest and lowest water, mean stage, and monthly range at 132 river stations are given in Table XI. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*Geo. E. Hunt, Chief Clerk, Forecast Division.*